WILLARD BAY RESERVOIR

Introduction

Willard Reservoir is a portion of the Great Salt Lake that was diked off and dewatered. It was then filled with water from the Weber River that would otherwise have flowed into the Great Salt Lake, and stored for irrigation and other uses as may be needed on the northern Wasatch Front. It is located west of Willard and Willard Peak, and is bounded by I-15 on its extreme eastern end. It is readily viable from I-15 and is directly adjacent to the Great Salt Lake. At 10,000 surface acres, this is by far the largest reservoir in the most northern part of Utah. A state park with full facilities is on the northeastern shore. It is also known as Willard Bay Reservoir or Arthur V. Watkins Reservoir.

Characteristics and Morphometry

Lake elevation (meters / feet)	1,287 / 4,223
Surface area (hectares / acres)	4,047 / 10,000
Watershed area (hectares / acres)	485,830 / 1,200,000
Volume (m^3 / acre-feet)	
capacity	238,435,910 / 193,300
conservation pool	0
Annual inflow (m^3 / acre-feet)	188,108,750 / 152,500
Retention time (years)	1.4
Drawdown (m^3 / acre-feet)	62,754,409 / 50,875
Depth (meters / feet)	
maximum	11 / 36.1
mean	5.9 / 19.4
Length (km / miles)	9.2 / 5.7
Width (km / miles)	7.4 / 4.6
Shoreline (km / miles)	25.2 / 15.6

Location

County	Box Elder
Longitude / Latitude	112 05 27 / 41 22 32
USGS Maps	Willard 1955, Plain City 1955, Plain City SW 1972
DeLorme's Utah Atlas & Gazetteer™	Page 60, B-2 - C-2
Cataloging Unit	Great Salt Lake (16020310)

Willard Reservoir was created in 1964 by the construction of 14 mile long rectangular earthen dike, enabling the reservoir to be filled 20 feet above the elevation of the Great Salt Lake. Reservoir shoreline is owned by the Department of the Interior and the State of Utah. Public access is unrestricted, but usage fees are charged in the state park areas. Reservoir water is used for irrigation (both

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suburban and agricultural) (85%) and culinary (15%). The Weber River Water Conservancy District administers the water use. Water is pumped in and out as it is available or needed elsewhere in the district. The fraction allotted to culinary use will probably increase as suburban growth continues to displace agricultural land. This reservoir may also play a vital part in the development of Bear River water for use on the Wasatch Front.

Recreation

Willard Reservoir is accessible from I-15 between Ogden and Brigham City. The primary recreation area is at the Willard Exit (Exit 360). It is only a short distance west of the freeway to the recreation area. A recreational area on the southern part of the reservoir is just three miles west of I-15 at Exit 354. Both locations are well marked and easily accessed on paved roads.

Fishing, boating, sailing, swimming, picnicking, camping, and water skiing are all popular. This is the largest body of fresh water in the Salt Lake Valley. The low elevation results in warmer air and water temperatures than in mountain reservoirs, making water recreation a prime importance earlier in the spring and later in the fall.

Recreational facilities at the reservoir include marinas for either daily or seasonal slip rental, campsites (62 in the north, 30 in the south), modern rest rooms, hot showers, fish cleaning stations, picnic areas, swimming areas, and concessionaires with gas, refreshments, groceries, and sundries. The south site also has boat rentals. The north area is open all year, while the south area is closed during the winter. In 1992, the park recorded 270,791 visitors, ranging from 1,103 in January to 59,022 in July.

There is a private campground in Willard Town (See info box).

Watershed Description

Willard Reservoir's natural watershed consists of Willard Peak and the narrow strip of valley floor between the mountain and the reservoir. This is the area that has always drained into Willard Bay of the Great Salt Lake. Willard Peak, one of the highest and most spectacular parts of the northern Wasatch Front, rises a mile feet above the reservoir to 2,976 m (9,764 feet), forming a complex slope of 29.2% to the reservoir. The entire face of the mountain is almost entirely exposed rock with slopes of 100%. Jagged teeth rise hundreds of feet above narrow draws.

Only a small percentage of the inflow comes from the natural watershed, though, and much of it is diverted for agricultural use south of Willard. Most of the inflow comes in through the Willard Canal, which is a diversion of the Weber River in Ogden. The Weber River watershed covers much of the back side of the Wasatch Front, the land east of the Wasatch Front, and a small portion of the eastern Uintas. The mountainous areas have heavy precipitation and are forested, while the other areas, including the watersheds of Cottonwood Canyon, much of East Canyon Creek, Lost Creek, Echo Canyon, Chalk Creek, and all areas along the Weber River, have rolling hills with predominantly sage-grass vegetation interspersed with aspen and spruce-fir in higher elevations and north facing slopes.

The Weber River watershed high point, Bald Mountain in the Uintas, is m (11,947 ft) above sea level, thereby developing a complex slope of 2.8% to the reservoir. Because there is no gradient to the Willard Canal, water can be transported in either direction depending upon the need. The average stream gradient of the lower Weber River is about 0.5% (25 feet per mile). The inflow and outflow is the Willard Canal depending upon which way the water is pumped into the canal. Several streams flow in from the natural watershed, including Willard Creek, Cold Springs Creek, and First Salt Creek. Upstream impoundments include East Canyon Reservoir, Lost Creek Reservoir, Echo Reservoir, Rockport Lake, and Smith and Morehouse Reservoir.

The watershed is made up of high mountains, mountains valleys, plateaus, lake terraces, alluvial fans, valley bottoms, and playas. The soil associations that compose the watershed are listed in Appendix III.

The vegetation communities consist of alpine, pine, aspen, spruce-fir, oak-maple, sage-grass, shadscale and greasewood. The watershed receives 30 - 102 cm (12 - 40 inches) of precipitation annually. The frost-free season around the reservoir is 140 - 160 days per year.

Land use in the watershed has not been quantified. The area along the Wasatch Front is urban, and upstream urban areas include Morgan, Henefer, Coalville, Kamas, the Snyderville Basin, and Park City. Mountain valleys are used for agriculture, with the exception of the Snyderville Basin, which is suburban. National Forest and BLM lands a r e

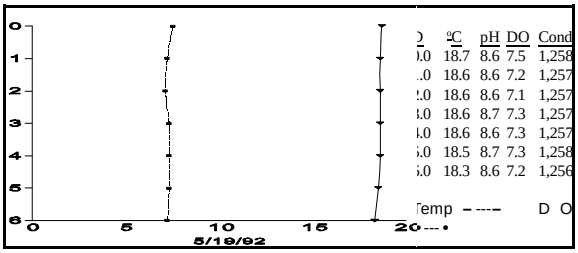
predominantly multiple use, with some logging taking place at the headwaters of the Weber and a few mining operations scattered throughout the watershed. Much of the watershed (probably well over 50%) is private grazing land, including almost all of every major tributary watershed to the Weber River. Private lands are subject to various types of development.

Limnological Assessment

The water quality of Willard Bay Reservoir is fairly good. It is considered to be hard with a hardness concentration value of approximately 223 mg/L (CaCO3). The one parameters that has exceeded State water quality standards for defined beneficial uses is total phosphorus. The average concentration of total phosphorus in the water column for the two study periods is 67.5 and 75 ug/L which both exceed the recommended pollution indicator for phosphorus of 25 ug/L.

Data suggest that the reservoir is currently a nitrogen limited system. TSI values indicate the reservoir is very productive in a state of eutrophic to hypereutrophic conditions. The reservoir typically does not stratify due to the shallow nature of the reservoir. The profile from May 19,1992 although early in the year, substantiates the uniform conditions typically found in the water column.

According to DWR no fish kills have been reported in recent years. The reservoir supports populations of black crappie (*Pomoxis nigromaculatus*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ictalurus melas*), bluegill (*Lepomis macrochirus*), walleye (*Stizostedion vitreum*), spot tailed shiner (*Notropis hudsonius*), sand shiner (*Notropis stramineus*), and white ass (*Morone chrysops*). *Potamogeton* is the dominant submergent macrophyte. Bottom fauna are primarily chironomids and oligochaete. Zooplankton include *Daphnia*, *Diaptomus*, *Nauplius*, and *Rotifers*.



The lake has not been treated for rough fish competition, but there are no native fishes in the reservoir. DWR does not conduct an annual stocking program but relies upon the perpetuation of those species present in the reservoir.

The reservoir has not been treated by the DWR to control rough fish competition, but there are no fishes native to Willard Bay, as it was originally part of the Great Salt Lake.

Phytoplankton in the euphotic zone include the following taxa (in order of dominance)

Species	Cell Volume (mm^3/liter)	% Density By Volume
Centric diatoms	4.226	41.41
Pennate diatoms	4.048	39.67
Unknown spherical green alga	0.545	5.34
Staurastrum sp.	0.500	4.90
Melosira granulata	0.375	3.67
Ankistrodesmus falcatus	0.201	1.97
Trachelomonas sp.	0.178	1.74
Euglena sp.	0.033	0.33
Chlamydomonas sp.	0.033	0.33
Phacus sp.	0.028	0.27
Scenedesmus sp.	0.025	0.25
Oscillatoria sp.	0.012	0.12
Total	1.925	
Shannon-Weaver [H']	1.38	

Limnological Data

Data averaged from STORET sites: 492044, 492045, 492046, 492047

Surface Data	1979	1992
Trophic Status	E	H
Chlorophyll TSI	50.46	50.73
Secchi Depth TSI	60.43	71.93
Phosphorous TSI	63.31	65.85
Average TSI	58.07	62.84
Chlorophyll a (ug/L)	-	8
Transparency (m)	1.1	0.43
Total Phosphorous (ug/L)	67.5	73
pH	8.6	8.4
Total Susp. Solids (mg/L)	-	18
Total Volatile Solids (mg/L)	-	4
Total Residual Solids (mg/L)	-	14
Temperature (ºC / ºf)	19/67	20/68
Conductivity (umhos.cm)	800	1346
Water Column Data		
Ammonia (mg/L)	0.07	0.03
Nitrate/Nitrite (mg/L)	0.12	0.02
Hardness (mg/L)	210	235
Alkalinity (mg/L)	175	177
Silica (mg/L)	2.5	11.6
Total Phosphorous (ug/L)	67.5	75
Miscellaneous Data		
Limiting Nutrient	N	N
DO (Mg/l) at 75% depth	6.9	8.4
Stratification (m)	NO	NO
Depth at Deepest Site (m)	4	3.0

Species Evenness	0.56
Species Richness	0.48

The phytoplankton community is dominated by the presence of diatoms, green algae and desmids. This is indicative of fairly good water quality

Pollution Assessment

Nonpoint pollution sources include the following: urban runoff; wastes and litter from recreation; sedimentation and nutrients from agricultural runoff and grazing; mining and logging. The areas of greatest impact are urban storm water runoff and grazing lands. Stormwater runoff can produce a variety of pollutants washed from streets and 7

areas associated from urban communities. Grazing activities have contributed to the movement of sediments and waste material from the watershed into the reservoir.

There are several significant point sources in the watershed that contribute a variety of potential pollutants. These sources include municipal and industrial dischargers.

Beneficial Use Classification

The state beneficial use classifications include: culinary (1C), boating and similar recreation (excluding swimming) (2B), warm water game fish and organisms in their food chain (3B), wildfowl and associated organisms (3D), and agricultural uses (4).

Information

Management Agencies	
Bear River Association of Governments	752-7242
Division of Wildlife Resources	538-4700
Division of Water Quality	538-6146
Recreation	
Golden Spike Empire Travel Region (Ogden)	627-8288
Brigham City Chamber of Commerce	723-3931
Willard Bay State Park	734-9494
RV Acres (Willard)	723-7000
Reservoir Administrators	
Weber River Water Conservancy District	
DOI	
Grant Salter	771-1677